

AQUEOUS ALTERNATIVES TO **CFC-113** & **MCF** FOR  
PRECISION CLEANING OF INERTIAL SYSTEMS & COMPONENTS

Prepared by:

Thomas L. Ciupak  
Capt. George Letourneau  
and  
Don E. Hunt

Presented by:

Thomas L. Ciupak

Mechanical Engineer - Aircraft Product Engineering Branch  
Directorate of Maintenance  
Aerospace Guidance & Metrology Center (AGMC)  
Newark Air Force Base, Ohio 43057-5149  
United States of America

Commercial Phone: (614) 522-8805  
DSN: 346-8805

December 4, 1991

**DISTRIBUTION STATEMENT 1**

Approved for public release  
Distribution Unlimited

**DTIC QUALITY INSPECTED 2**

19971210 088

New Text Document.txt

10 December 1997

This paper was downloaded from the Internet.

Distribution Statement A: Approved for public release;  
distribution is unlimited.

Aerospace Guidance and Metrology Center  
Newark Air Force Base, OH

Date: December 1991

12

### PURPOSE

The purpose of the study was to establish a baseline for CFC-113 emissions and other losses that result from maintenance operations at AGMC. A total of 314,000 lb of CFC-113 was purchased in FY-1991. A great deal of it is emitted to the atmosphere. There are a large number of individual CFC-113 emission point sources located throughout building 4. The most significant CFC-113 emission sources and other loss sources in Directorate of Maintenance activities are:

- A. Spraybooths
- B. Sumps
- c. Drums
- D. Open Containers
- E. Degreasers
- F. House Vacuum
- G. CFC-113 Truck
- H. CFC-113 Still

A. SPRAYBOOTHS: According to the Acurex Corporation study and MAEL(4) records, CFC-113 use in spraybooths account for 130,562 lb/yr. The spraybooths in this category are those not connected to carbon adsorption units. The exhaust duct carrying solvent vapor from the spraybooth located in the displacement gyro area was monitored for the quantity of CFC-113 vapor vented during normal operation. It was found that 63% of the CFC-113 used had

evaporated before it reached the sump. If this measurement is representative of other spraybooths, 42% of the purchased CFC-113 is evaporated through the system.

B. SUMP: The evaporation rate from a sump was determined at the Physical Science Laboratory by pouring a measured amount of CFC-113 into a sump and then measuring the amount of CFC-113 left after a 24 hour period. The rate of evaporation of CFC-113 was found to be 18% per 24 hour period. If the rate of evaporation is assumed to be uniform for all the sumps (40 sumps in the building), then one can divide the unevaporated CFC-113 by 0.82 and multiply the results by 0.18 to obtain the total amount of evaporation. The total CFC-113 evaporated from the sumps was then divided by the annual CFC-113 purchase to get percent evaporation. It was determined that 30% of the annual purchase is evaporated from the sumps.

C. DRUMS: Some CFC-113 used at AGMC is contaminated with solutions not compatible with the distillation system. This must be disposed of as hazardous waste. According to Environmental Management records, 31,847 lb of CFC-113 was sold to a contractor as hazardous waste last year. This accounts for 10% of the purchased CFC-113.

D. OPEN CONTAINERS: A survey was performed in Building 4 to determine the amount of CFC-113 lost from open container applications. Based on the survey, about 146,500 lb of CFC-113 is used annually. A rate of evaporation was determined by measuring evaporation from containers similar to those used in

the production areas. The rate of evaporation was determined to be 11%. Using this information, it can be shown that 5% of the purchased CFC-113 is lost from open containers annually.

E. DEGREASERS: A degreaser is designed to keep volatile organic compounds from escaping the equipment during use. The annual CFC-113 use in degreasers is estimated to be 159,500 lb. Assuming that the degreasers are used properly, only 1% of the actual CFC-113 used is evaporated while filling and emptying the tanks and inserting and removing parts. Based on this assumption, 1,595 lb/yr is evaporated, which is 1% of the annual CFC-113 purchased.

F. HOUSE VACUUM: The CFC-113 lost through the house vacuum system was, investigated using Infrared Spectrometry. An assumption was made for the second and third shift operations, that the work load on those shifts was one third of that performed on the first shift. It was determined from the data gathered that the CFC-113 loss through the house vacuum system is approximately 14,000 lb/yr. Based on this calculation, 5% of the purchased CFC-113 is lost through the house vacuum system.

G. CFC-113 TRUCK: When filling the Virgin Tank from the CFC-113 truck about 2,000 lb/yr of vapor is retained in the truck. This loss is about 1% of the purchased CFC-113.

H. CFC-113 STILL: It has been determined that the distillation and holding tank at the still for CFC-113 are emitting about 2.5% of the total reclaimed CFC-113. This loss accounts for 4% of the evaporation of the purchased CFC-113.

#### CONCLUSIONS

The total account of CFC-113 lost from the point sources based on last year's purchases are as follows (see Figure 1):

A. Spraybooths	42%
B. Sumps	30%
C. Drums	10%
D. Open Containers	5%
E. Degreasers	1%
F. House Vacuum	5%
G. CFC-113 Truck	1%
H. CFC-113 Still	4%
I. Unaccounted loss	2.4%

# FREON LOSSES

BASED ON 1991 PURCHASES

314,000 LBS = 100%

sumps 30%

FREON TRUCK 1%  
HOUSE VAC 5%

DRUMS 10%

DEGREASERS 1%

OPEN CONTAINERS 5%

UNACCOUNTED 2%

FREON STILL 4%

